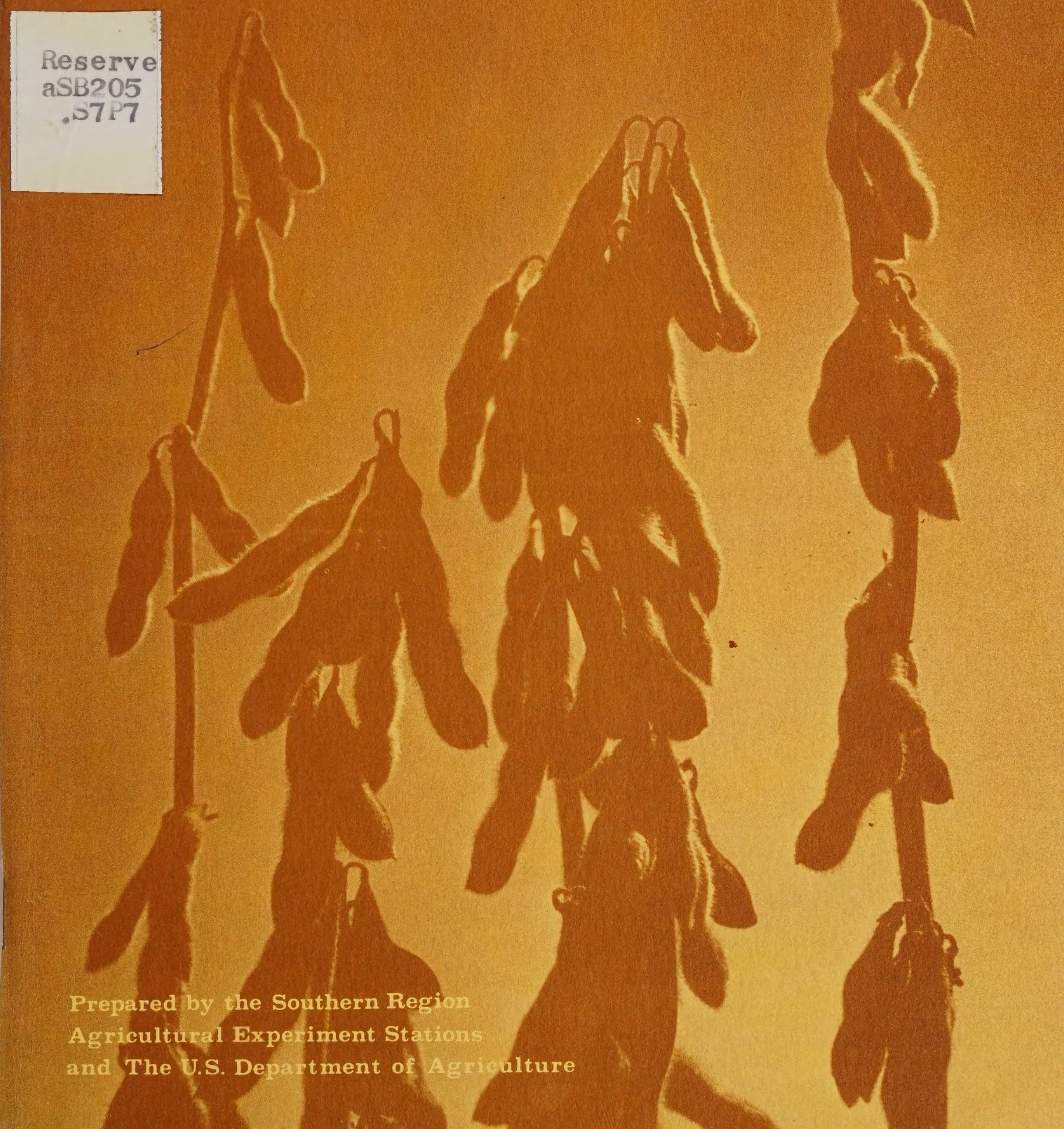
Soybean Task Force Report Southern Region 1975



Prepared by the Southern Region
Agricultural Experiment Stations
and The U.S. Department of Agriculture

A Program of Research For the Southern Region In SOYBEANS

Prepared by:

A Joint Task Force of
The Southern Region
Agricultural Experiment
Stations and the U.S.
Department of Agriculture

CONTENTS

Page

PREFACE 3

TASK FORCE MEMBERS 4

FOREWORD 6

Priority Ranking of Sub-RPAs Within Each RPA and Overall Sub-RPAs in Southern Region of the United States 9

Number of State Agricultural Experiment Stations Indicating A Priority for Support for Ongoing Programs or for New SYs in Each Sub-RPA and the Priority Placement of the USDA in Both Categories 11

Soybean Research Scientific Year (SY) Inputs (1974) By the Southern State Agricultural Experiment Stations 12

Soybean Research Scientific Year (SY) Needs of the Southern State Agricultural Experiment Stations (1974) 13

Soybean Research Scientific Year Inputs and Needs of USDA Agricultural Research Service (1974) 14

CROP PROTECTION 15

RPA 207

Biology and economic injury thresholds of insects attacking soybeans 16

Insecticidal methods for suppression of insect outbreaks . . 17

Noninsecticidal methods of insect pest population regulation 18

Management systems for soybean insect pests 19

RPA 208

Control of diseases through genetics and breeding 20

Crop sequence and management practices to reduce incidence of soybean diseases 21

The role of insects in transmission of soybean viruses . . . 22

Life histories of soybean pathogens and losses from soybean diseases 23

Identification and control of foreign diseases that may damage soybeans 24

The interaction of diseases caused by root and/or stem invading pathogens and other soil-related factors in reducing soybean yields 25

RPA 209

Practices for controlling weeds in soybeans with emphasis on integrated systems of control 26

Competition of weeds with soybeans 28

Conventional versus minimum tillage methods of weed control in soybean production 29

Page

Physiological, biological, and genetic responses of soybeans to weed control materials and methods 30

IMPROVEMENT OF BIOLOGICAL EFFICIENCY, MECHANIZATION, AND PRODUCTION SYSTEMS. 31

RPA 307, 308, and 309

Plant characteristics and management practices 32
Nutrient relationships and fertilization of soybeans . . . 33
More efficient energy storage by soybeans. 34
Nitrogen nutrition and utilization 35
Root-soil relationships 36
Genetics and breeding for higher seed yields 37
Growth regulators for soybeans 38
Evaluation of lands suitable for expanded acreage 39
Water relations in soybeans. 40
Physiological nature of resistance to growth and development hazards 41
Seed quality 42
Soybean production efficiency 43
Systems analysis for soybean production 44

UTILIZATION AND MARKETING 45

RPA 406, 407, 501, and 504

New and improved soybean protein food products 46
Food use of soybean oil 48
New and improved industrial products from soybean oil . . 49
Feed use of soybean meal 50
Improvement of grades and standards. 52
Physical efficiency in marketing soybeans 54
Economic efficiency in marketing soybeans and their products 55
Economic efficiency in marketing soybeans and their products 57

APPENDIX

Table 1. Soybeans - acreage harvested, 1964-1974. 58
Table 2. Soybeans - yield per acre. 59
Table 3. Soybean production.. 60
Table 4. Soybean - value of production. 61
Table 5. Soybeans - amount fed to livestock on farms where grown. 62
Table 6. Soybeans - amount used for seed on farm where grown. 63
Table 7. Soybeans - amount sold 64
Table 8. Soybeans - season average price per bushel. . . 65
Table 9. Soybeans - value of sales. 66
Table 10. Number of processors of soybeans by states, 1965-1974. 67
Table 11. Disposition of soybeans, 1964-1973. 68
Table 12. Soybeans: supply and disposition, U. S. 69

PREFACE

The Southern Regional Soybean Task Force is composed of representatives from the Agricultural Experiment Stations, the U.S. Department of Agriculture and the soybean industry. Members of this Task Force evaluated ongoing research efforts as they identified continuing and new research problem areas.

Determination of research needs in soybeans is a continuing process and will require re-evaluation by the Task Force from time to time. The Task Force invites your comments and criticisms as it moves forward in the identification of new problem areas and in the development of potential soybean research programs.

TASK FORCE MEMBERS

R. F. Anderson, Agricultural Economics, Georgia Experiment Station, Experiment, Georgia 31201.

*** E. B. Browne, Southern Experiment Station Directors' Respresentative, Associate Director, Georgia Agricultural Experiment Stations, Coastal Plain Experiment Station, Tifton, Georgia 31794.

C. E. Caviness, Soybean Breeding and Genetics, Agronomy Department, University of Arkansas, Fayetteville, Arkansas 72701.

R. A. Chapman, Nematology, Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40506.

Gaylord Coan, Gold Kist, Inc., P. O. Box 2210, Atlanta, Georgia 30001.

* W. L. Colville, Chairman, Agronomy Division, University of Georgia, Athens, Georgia 30602.

E. E. Hartwig, Soybean Breeding and Culture, USDA-ARS Crops Research Division, Delta Branch Experiment Station, Stoneville, Mississippi 38766.

E. W. Hauser, Weed Control, USDA-ARS, Department of Agronomy, Coastal Plain Experiment Station, Tifton, Georgia 31794.

H. J. Hodgson, USDA, CSRS Representative, Cooperative State Research Service, Washington, D.C. 20250.

Robert Judd, National Soybean Crop Improvement Council, 211 S. Race Street, Urbana, Illinois 61801.

** J. T. Kirkwood, Soil Microbiology, P. O. Drawer L, Prairie View A & M College, Prairie View, Texas 77845.

*** E. B. Knipling, Assistant Area Director, USDA-ARS Southern Region, Mississippi Valley Area, P. O. Box 225, Stoneville, Mississippi 30766.

L. L. McKinney, Soybean Utilization, USDA-ARS, Russell Research Laboratory, Athens, Georgia 30601.

William Prichard, Chairman, Georgia Commodity Commission for Soybeans and American Soybean Association Director, Louisville, Georgia 30343.

H. T. Rogers, Soils and Plant Nutrition, Department of Agronomy, Auburn University, Auburn, Alabama 36830.

J. P. Ross, Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27607.

C. A. Stutte, Soybean Plant Physiology, Department of Agronomy, University of Arkansas, Fayetteville, Arkansas 72701.

D. L. Tindal, American Soybean Association and American Soybean Association Research Foundation, Ten Dales Farm, Route 2, Box 78, Pinewood, South Carolina 29125.

S. G. Turnipseed, Entomology, Edisto Experiment Station, P. O. Box 247, Blackville, South Carolina 29817.

* Chairman.

** Represented by O. E. Smith, agronomist from Prairie View A & M, Texas.

*** Administrative Advisor.

FOREWORD

The rapid development of soybeans into a major agricultural crop in the southern states during the 1960's quickly consumed the available research and revealed a need for research pertinent to soybean production and marketing problems peculiar to this region. At the direction of the Southern Association of Experiment Station Directors, a Soybean Research Task Force for the Southern Region was activated. This report presents the results of the work assigned this group.

Data were assembled on soybean acreage, yields, production, value, and other factors for the Southern Region to measure the relative importance of this region in the soybean industry of the United States. These data are shown in Tables 1-12 of the Appendix.

Soybean acreage in the South has increased 114% during the 10-year period of 1964-1973. Nationally, the acreage increase has been 81% during the same period. Yields per acre increased 12% on the regional and 21% on the national scale. Increases in soybean production appear to have resulted from increased acreage rather than increased production per acre. A view of the total picture shows that as soybean acreages have increased, the crop has been grown on more of the less productive soils and in late-planted, double-cropping systems situations. This will explain in part why use of state yield figures to determine progress in research can be grossly misleading. Yields have increased at substantially faster rates in states with relatively stable acreages.

In 1973, soybeans returned $2,290,000,000 to the economy of the 13 southern states or approximately 26.3% of the nation's total income from the crop. Nearly 5.6 million bushels of these beans were used for on-farm or seed purposes. The remaining 99% were available for sale in domestic and foreign markets. Fifty percent of the total processors are found in the 13 southern states, in spite of the relatively low percentage of the total U.S. production.

A companion effort was undertaken to determine the scope of research underway on this crop. The Task Force reviewed CRIS reports relative to soybean research but found them inadequate for determining SYs or funding inputs with the degree of accuracy desired. Therefore, questionnaires were sent to each director and appropriate U. S. Department of Agriculture administrators requesting specific data. We believe this report presents a more reliable estimate of the ongoing research effort and needs than could be obtained from CRIS reports alone. These data are summarized on the following pages.

In fiscal 1973-74, the SAES in the Southern Region had 72.6 SYs involved in the various phases of soybean research. They indicated a further immediate need for an additional 72.9 SYs in soybean research SY inputs and needs as expressed by the USDA for the South indicate a doubling of effort to be necessary. U. S. Department of Agriculture inputs were 21.5 in 1974 whereas their indicated needs were for an additional 19.5 SYs.

The Task Force was asked to rate by priority each sub-RPA within an RPA, i.e., 207-A---207-D, and to rank each sub-RPA overall sub-RPAs, i.e., 207-A---504-C. Problems related to integrated weed control were ranked as the Number One priority for research in the Southern Region. Genetics and breeding (307-F), water relations (307-I), root-soil relations (307-E), and crop sequences and management practices as related to disease (208-B) complete the top five priority RPAs. It is recognized that individual states may have overriding priorities.

Task Force recommendations for new or additional soybean research are in the general areas of protection, production, utilization, and marketing. Many of the problem areas outlined emphasize the need for research directed towards problems peculiar to the Southern Region. Disease, insect, nematode, soil, and environmental problems, along with a differing plant type, must be dealt with in the South because they differ widely from those in other regions.

The SAES and USDA priority on additional support for ongoing programs or for additional SYs is shown in a table on Page 11. Support for existing programs is considered to be of uppermost importance.

Centers of emphasis should be developed within the Southern Region.

For example, there is little need for several stations competing in secondary evaluation of herbicides. However, when it comes to advanced herbicide evaluation, each state must determine when, how, where and under what conditions an herbicide fits its needs.

Certain components of soybean research can be "nationalized." In particular, utilization is and can continue to be concentrated at the Northern Utilization Laboratory at Peoria, Illinois. Limited research on problems peculiar to the South, such as protein supplementation to human diets, should be conducted on site. Aspects of marketing must be considered in the same concept.

Interdisciplinary research efforts must be encouraged at all levels of administration. "Sweetening the pot" with funds from the several soybean check-off programs, the American Soybean Association, and related commodity groups has increased the interest in the soybean as an organism and as a crop with great potential in the Southern Region. The data base is in certain instances increasing faster than technology is being adapted. A concentrated educational program designed to acquaint the researcher, producer and consumer with soybean production, marketing and utilization can and should be emphasized as a major need. Efficient transmittal of research results across the region through educational programs could have the dual advantage of reducing duplication of effort by states and encouraging specialization of research on specific problems by individual states.

PRIORITY RANKING OF SUB-RPAs WITHIN EACH RPA AND OVERALL SUB-RPAs IN SOUTHERN REGION OF THE UNITED STATES

RPA	Sub-RPA Title	Priority Within RPA	Priority Overall Sub-RPAs
207-A	Biology and Economic Injury Thresholds of Insects Attacking Soybeans	3	14
207-B	Insecticidal Methods for Suppression of Insect Outbreaks	4	17
207-C	Noninsecticidal Methods of Insect Pest Population Regulation	1	5
207-D	Management Systems for Soybean Insect Pests	2	7
208-A	Control of Diseases Through Genetics and Breeding	1	10
208-B	Crop Sequence and Management Practices to Reduce Incidence of Soybean Diseases	1	5
208-C	The Role of Insects in Transmission of Soybean Viruses	3	23
208-D	Life Histories of Soybean Pathogens and Losses from Soybean Diseases	3	20
208-E	Identification and Control of Foreign Diseases that May Damage Soybeans	4	33
208-F	The Interaction of Diseases Caused by Root and/or Stem Invading Pathogens and Other Soil-Related Factors in Reducing Soybean Yields	2	8
209-A	Practices for Controlling Weeds in Soybeans with Emphasis on Integrated Systems of Control	1	1
209-B	Competition of Weeds with Soybeans	4	16
209-C	Conventional Versus Minimum Tillage Methods of Weed Control in Soybean Production	3	22
209-D	Physiological, Biological, and Genetic Responses of Soybeans to Weed Control Materials and Methods	2	11
307-A	Plant Characteristics and Management Practices	6	8
307-B	Nutrient Relationships and Fertilization of Soybeans	6	13
307-C	More Efficient Energy Storage by Soybeans	4	10

RPA	Sub-RPA Title	Priority Within RPA	Priority Overall Sub-RPAs
307-D	Nitrogen Nutrition and Utilization	5	12
307-E	Root-Soil Relationships	3	4
307-F	Genetics and Breeding for Higher Seed Yields	2	2
307-G	Growth Regulators for Soybeans	7	15
307-H	Evaluation of Lands Suitable for Expanded Acreage	7	18
307-I	Water Relations in Soybeans	1	3
307-J	Physiological Nature of Resistance to Growth and Development Hazards	8	17
307-K	Seed Quality	9	20
308	Mechanization of Soybean Production	1	19
309	Systems Analysis for Soybean Production	1	24
406-A	New and Improved Soybean Protein Food Products	1	25
406-B	Food Use of Soybean Oil	2	30
407-A	New and Improved Industrial Products from Soybean Oil	2	31
407-B	Feed Use of Soybean Meal	1	31
501	Improvement of Grades and Standards	1	26
504-A	Physical Efficiency in Marketing Soybeans	1	29
504-B	Economic Efficiency in Marketing Soybeans and their Products (regional study)	3	28
504-C	Economic Efficiency in Marketing Soybeans and their Products (on-farm study)	2	27

NUMBER OF STATE AGRICULTURAL EXPERIMENT STATIONS INDICATING A PRIORITY FOR SUPPORT FOR ONGOING PROGRAMS OR FOR NEW SYs IN EACH SUB-RPA AND THE PRIORITY PLACEMENT OF THE USDA IN BOTH CATEGORIES.

RPA		SAES: Number indicating priority for: Additional support, current programs	SAES: New SY support	USDA: Priority: Additional support, current programs	USDA: New SY support
207	A	6	5	X	--
	B	5	2	--	--
	C	4	7	--	X
	D	4	5	--	X
208	A	5	5	X	--
	B	6	3	--	X
	C	3	2	--	--
	D	5	3	X	--
	E	2	--	--	--
	F	7	3	X	--
209	A	7	5	--	X
	B	3	5	X	--
	C	9	3	--	X
	D	4	2	X	--
307	A	5	8	X	--
	B	8	4	--	--
	C	5	2	--	X
	D	5	1	--	X
	E	5	5	--	X
	F	7	6	X	--
	G	6	0	--	--
	H	4	3	--	--
	I	4	2	--	X
	J	3	1	X	--
	K	5	3	X	--
308		--	--	--	--
309		--	--	--	--
406	A	4	3	--	--
	B	1	1	--	--
407	A	1	--	--	--
	B	1	1	--	X
501		1	1	--	--
504	A	2	1	X	--
	B	3	1	--	--
	C	2	4	--	--

SOYBEAN RESEARCH SCIENTIFIC YEAR (SY) INPUTS (1974)
BY THE SOUTHERN STATE AGRICULTURAL EXPERIMENT STATIONS

RPA	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	Okla.	N.C.	S.C.	Tenn.	Tex.	Vir.	TOTAL
207	.3	2.0	.8	1.0	.9	.9	.3	--	1.3	3.0	.3	.1	.8	11.7
208	.4	3.6	1.3	2.0	.5	.7	.8	--	.2	1.8	1.4	.4	.1	13.2
209	.5	1.0	.5	1.2	1.5	.7	2.3	--	.4	1.0	.7	.3	.8	10.9
307	1.4	3.7	.6	4.4	2.8	3.9	5.6	--	1.2	1.3	1.4	1.9	2.3	30.5
308	.2	--	--	.1	--	.3	--	--	--	--	1.0	--	.2	1.8
309	--	--	--	--	--	.4	.2	--	--	--	1.0	--	--	1.6
406	--	--	.1	.5	--	.2	--	--	.2	--	--	.1	--	1.1
407	--	.1	--	--	--	--	--	--	.1	--	--	--	--	.2
408	--	--	--	--	--	.3	--	--	--	--	--	--	--	.3
501	--	--	--	--	--	.2	--	--	--	--	--	--	--	.2
503	--	--	--	--	--	.3	--	--	--	--	--	--	--	.3
504	.2	--	--	--	--	--	--	--	.6	--	--	--	--	.8
TOTAL	3.0	10.4	3.3	9.2	5.7	7.9	9.2	--	4.0	7.1	5.8	2.8	4.2	72.6

SOYBEAN RESEARCH SCIENTIFIC YEAR (SY) NEEDS
OF THE SOUTHERN STATE AGRICULTURAL EXPERIMENT STATIONS (1974)

RPA	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	Okla.	N.C.	S.C.	Tenn.	Tex.	Vir.	TOTAL
207	.5	1.4	.2	2.5	--	1.3	3.0	.5	1.0	2.2	.2	--	--	12.8
208	.5	2.2	1.2	.5	.5	.8	1.0	.3	1.0	1.1	.2	--	.8	10.1
209	.3	.5	.3	.7	1.5	.6	--	.4	.3	1.9	.2	.4	--	7.1
307	.7	3.9	2.4	3.8	3.5	1.6	2.9	.4	1.2	5.5	.5	2.0	.4	28.8
308	.1	.5	.2	.5	--	.1	--	--	--	1.3	--	--	.2	2.9
309	--	--	.3	--	--	.2	--	--	--	1.8	--	--	--	2.3
406	--	1.0	.2	1.6	--	.1	--	--	--	1.1	--	--	--	4.0
407	--	.5	--	--	--	--	--	--	--	--	--	--	--	.5
408	--	--	--	--	--	--	--	--	--	--	--	--	--	--
501	--	--	--	--	--	--	--	--	--	.5	--	--	--	--
503	--	--	--	--	--	--	--	--	--	--	--	--	--	--
504	.2	1.0	.4	--	--	.3	--	--	--	2.0	--	--	--	3.9
TOTAL	2.3	11.0	5.2	9.6	5.5	5.0	6.9	1.6	3.5	17.4	1.1	2.4	1.4	72.9

SOYBEAN RESEARCH SCIENTIFIC YEAR INPUTS AND NEEDS
OF USDA AGRICULTURAL RESEARCH SERVICE (1974)

RPA	Inputs	Needs
207	4.1	2.2
208	3.5	.2
209	4.1	6.7
307	9.2	3.2
308	--	6.0
309	.2	1.2
406	--	--
407	--	--
501	--	--
504	.4	--
TOTAL	21.5	19.5

CROP PROTECTION

RPA 207, 208, and 209

General problems of protecting soybeans from insects (RPA 207), diseases (RPA 208), and weeds (RPA 209) were adequately defined in the National Task Force Report. The fact that economic losses from these pests is much greater in southern soybean producing areas was not mentioned.

Protection problems in the Southern Region require immediate attention through increased funding, research expertise and coordination of efforts. Soybean acreage in the Southern Region has more than doubled during the past 10 years and there have been corresponding increases in numbers and kinds of pests associated with the crop. National soybean acreage will continue to expand with healthy marketing situations. Most of this continuing expansion will occur in the Southern Region.

Integrated pest control research is emphasized throughout these RPAs. Research efforts have pointed to the compounding of pest problems through use of materials or methods devised for specific single or groups or organisms. For example, the use of fungicides for control of plant diseases has also reduced the occurrence of disease organisms affecting certain insect pests.

Previous experience has shown that with a changing ecosystem, approaching a virtual monocrop culture in many areas, pest populations also change and will continue to fluctuate for several years after maximum acreage has been attained. Those responsible for direction of research efforts must not neglect the potentially dangerous situation relative to soybean protection that is evolving in our region. The magnitude of this situation is further compounded by restrictions being placed on chemicals that are presently our only effective and economical method for insect and weed control.

Little is known concerning the separate economic impact of below-ground insects, nematodes and diseases. We do know that these organisms seldom if ever act entirely alone in causing economic losses. Virtually nothing is known about interactions of soil pests.

It is imperative that a concentrated and unfragmented research program be developed in the area of soil protection interactions. Thought should be given to: (1) the establishment of a "center of emphasis" with expertise in nematology, soil entomology, soil microbiology, and related disciplines, or (2) scientists in these disciplines may be located at several institutions with close research coordination through a regional project. Also, it is difficult to separate soil protection from soil production problems. Therefore, competent production researchers should be available to supplement pest management programs.

BIOLOGY AND ECONOMIC INJURY THRESHOLDS OF INSECTS ATTACKING SOYBEANS

RPA 207-A (3*-14**)

Situation: Insects that attack soybeans have increased in kinds and numbers with the rapidly increasing acreage of soybeans in the Southern Region. Most of these insects were first present on other crops or weeds and are now adapting to soybeans as host plants. Although the biology and to a lesser extent the economic injury thresholds of soybean-feeding insects have been determined on other host plants, relatively little information is available concerning their biology and economic impact on soybean production. Increased research efforts are necessary to adequately determine the biology and economic injury thresholds of insects associated with the various soybean agroecosystems in the Southern Region.

Objective: To determine the biology (including occurrence, distribution, abundance, habits, nutritional requirements, and other ecological characteristics) and economic injury thresholds of the complex of insect pests of soybeans and utilize this information as a base for developing effective pest management practice.

Research Approaches:

A. Determine the seasonal habits (including mating, feeding, and migration), preference for alternate host plants, and population dynamics of major soybean insects, and establish life tables for the different agroecosystems. Use appropriate sampling methods that can be related to absolute population levels, at any population density.

B. Establish economic injury thresholds for individual pest species and more importantly for pest complexes in as many major ecosystems as possible (different pest species may feed on virtually all plant parts simultaneously. Accurate and detailed records should be taken on numbers and stages of pest species present and actual plant damage (no. pods destroyed, % defoliation, etc.). Numbers and damage should be correlated to crop loss (yield and quality).

C. Determine the effect of different cropping systems and production practices on insect populations (pests and beneficials).

Potential Benefits: Reduce production costs and enhance environmental quality by more judicious use of applied control measures (including chemical insecticides).

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.5	3.8	6 1/	5 1/
USDA	1.6	0.5	X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

INSECTICIDAL METHODS FOR SUPPRESSION OF INSECT OUTBREAKS

RPA 207-B (4*-17**)

Situation: The use of conventional "chemical" insecticides is necessary to control pest outbreaks on soybeans. However, broad spectrum chemicals are often being applied when unnecessary and frequently at unnecessarily high rates. These high use and dose rates occur because: (1) growers prefer and have been encouraged to apply rates that will "clean up" the most difficult to kill of the insect complex, often whether the insect is present or not, and (2) research has not provided adequate data on economic injury thresholds and effective minimum rates of recommended insecticides against different pest species. Microbial insecticides which include advanced strains of Bacillus thuringiensis have shown promise against lepidopterous larvae, but such materials are not presently available for grower use due to inadequate research and development. Recent data from minimum rate studies by researchers cooperating through regional project S-74 have indicated that certain pests are controlled effectively and beneficial predators survive reduced rates of presently recommended conventional chemical insecticides. Expanded research in this area should lead to use of chemicals that allow adequate survival of beneficial species, reduce resurgence of pest species and result in savings to growers.

Objective: To develop cheaper and more effective insecticidal control methods that will leave no objectionable residues in soybeans, cause minimum kill of beneficial species, and be nonhazardous to higher animals.

Research Approaches:

A. Test selective and non-selective chemical insecticides used selectively for activity against major pests and beneficials. Include various formulations, rates, times of application and equipment.

B. Evaluate the potential role of microbial insecticides for integration into pest management programs. Include assessment of mixtures of entomopathogenic agents, mixtures of pathogens with insecticides, different formulations and techniques of application.

C. Determine insecticide residues in seed, oil, meal, and forage.

D. Establish regional areas for field evaluation of new chemical and microbial insecticides. This will avoid unnecessary duplication and allow more concentration of research effort. Such areas may include lower mid-South (Louisiana), upper mid-South (Arkansas, west Tennessee or north-west Mississippi), Southeast (south Alabama, south Georgia or Florida panhandle), and lower Atlantic Coast (South Carolina).

Potential Benefits: Provide effective and economical insecticidal methods for control of pest outbreaks, improve and maintain environmental quality, preserve natural enemies of pest species and reduce applicator and residue hazards.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.1	1.0	5 1/	2 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

NONINSECTICIDAL METHODS OF INSECT PEST POPULATION REGULATION

RPA 207-C (1*-5**)

Situation: Insect control on soybeans depends almost solely upon applications of broad-spectrum chemicals against pest outbreaks. Although environmental quality has probably not been adversely affected due to infrequent applications upon a relatively small percent of acreage, this "chemical dependency" is undesirable. A single mid-season application of a highly active chemical may control a pest species for a week or so, but may effectively eliminate important predators (geocorids, nabids and spiders) as natural control agents for the remainder of the season. This may result in a later resurgence of the target pest or may cause higher numbers of other pests later in the season than would have occurred without any chemical insecticide. Recent research results indicate that noninsecticidal methods such as host plant resistance, manipulation or predators and parasites, microbial pathogens and cultural practices may be utilized to regulate pest populations at non-economic levels. Increased and concerted efforts are necessary in these areas to reduce the incidence of pest outbreaks and insecticidal applications.

Objective: To develop soybean varieties with resistance to major pest species, and determine the chemical physiological, or morphological nature of resistance; to determine the importance of beneficial organisms, including indigenous and exotic predators, parasites and diseases; to evaluate cultural methods for control.

Research Approaches:

A. Collect and evaluate soybean germ plasm for insect resistance, transfer resistance to adapted varieties, and determine the nature and inheritance of resistance.

B. Conduct studies on parasites, predators and disease producing pathogens; develop techniques for quantity production and test these organisms for regulation of pest populations in the field.

C. Evaluate cultural control practices (including trap crop control, crop interplanting to enhance beneficials and abate pests, effect of plant populations, and minimum tillage) and develop appropriate methods for integration into pest management systems.

D. Investigate potential of other population-regulating methods such as sterilization techniques, sex attractants, growth-regulating hormones and genetic manipulation of both pests and beneficials.

Potential Benefits: Reduce cost of production and increase yield and quality.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.9	3.5	4 1/	7 1/
USDA	2.0	1.0		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

MANAGEMENT SYSTEMS FOR SOYBEAN INSECT PESTS

RPA 207-D (2*-7**)

Situation: The gradual development of alternative methods of pest population regulation that do not depend on application of broad spectrum chemicals will necessitate the orderly integration of such methods into effective pest management systems. These systems should provide the analytical framework and the mathematical and statistical techniques for decision-making in pest control. As necessary data are obtained on methods indicated in RPA 207 A-C, these methods must be field-tested as integrated units against pest species in the various agro-ecosystems with necessary attention given to economic and social considerations.

Objective: To develop effective and socially acceptable management systems for insect pests of soybeans through integration of various population-regulating practices.

Research Approaches:

A. Integrate data (as available) on biology of pest and beneficial species, economic injury thresholds, insecticidal and noninsecticidal methods of population regulation into effective pest management systems.

B. Obtain necessary mathematical and statistical techniques for analyses of the systems (this will require continuing evaluation of the type data necessary and continuing modification of theory).

Potential Benefits: Improve ecological, economical and social aspects relative to soybean insect control.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.2	4.4	4 1/	5 1/
USDA	0.5	0.7		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

CONTROL OF DISEASES THROUGH GENETICS AND BREEDING

RPA 208-A (1*-10**)

Situation: Soybean diseases increase the hazards of production. Bacterial pustule may reduce yields of susceptible varieties by 8 to 15 percent. Measurable yield reductions from target spot have been obtained with susceptible varieties in 60 percent of the years. These yield reductions have been as high as 50 percent. Phytophthora rot can completely destroy a crop. Brown stem rot is widely distributed. The cyst nematode can cause yield reductions of 50 to 100 percent and root-knot nematodes may cause severe injury. Genetic resistance has been identified for some serious soybean diseases but not for others. The losses due to soybean diseases are estimated to be about $250 million per year.

Objective: To identify sources of resistance to plant pathogens, determine the mode of inheritance, and transfer this resistance to productive, well-adapted varieties.

Research Approaches:

A. Observe available germ plasm for reaction to pathogens.

B. Study inheritance of host reaction to pathogens.

C. Conduct breeding programs to transfer resistance to productive, well-adapted varieties.

Potential Benefits: Hazards of production will be reduced, seed yields increased, and seed quality improved.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	4.3	5.0	5 1/	5 1/
USDA	1.3		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

CROP SEQUENCE AND MANAGEMENT PRACTICES TO REDUCE INCIDENCE OF SOYBEAN DISEASES

RPA 208-B (1*-5**)

Situation: Continuous cropping is known to increase the injury to soybeans resulting from cyst nematodes and brown stem rot. Crop rotation aids in control of these diseases. However, rotation with cotton increases the severity of injury from target spot and root-knot nematode. Crop sequence appears to have little influence upon injury from phytophthora rot. Certain weed species are believed to be carriers of viruses which infect soybeans. Methods of tillage and sanitation are effective in controlling certain diseases on other crops. Chemical control measures are of minor significance.

Objective: To study disease development on soybeans under different crop sequence systems, methods of tillage, and weed control programs, and to develop management practices to reduce losses due to diseases.

Research Approaches:

A. Study effectiveness of different crop sequences, planting patterns, and methods of seedbed preparation in controlling the principal soybean pathogens.

B. Determine alternate crops and weeds which may serve as hosts for soybean pathogens, and the effect of herbicides and other weed control practices on soybean diseases.

C. Study the effect of various cropping procedures and management practices on the soil microorganism balance in relation to soilborne pathogens.

D. Test chemical agents for systemic or localized control of diseases and develop techniques for the effective use of such agents.

Potential Benefits: Determination of the significance of changing crop sequence patterns in the incidence and control of soybean diseases; evidence of advantages and disadvantages of monoculture; identification of other plant species which may be significant in prevalence of soybean diseases.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.0	1.4	6 1/	3 1/
USDA	.4	.2		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

THE ROLE OF INSECTS IN TRANSMISSION OF SOYBEAN VIRUSES

RPA 208-C (3*-23**)

Situation: Several virus diseases such as soybean mosaic, bean pod mottle virus, tobacco ring spot virus, and yellow mosaic occur in soybeans. Soybean mosaic and bean pod mottle viruses when present together cause significant yield losses. Tobacco ring spot virus has caused complete loss through failure of seed set in localized areas. Other viruses may occur but have not been investigated. Insects are by far the most important agents of virus transmission. Soybean mosaic is transmitted by aphids, and bean pod mottle virus is spread by bean leaf beetle. Leafhoppers are suspected as a transmitter of tobacco ring spot virus but no vector has been positively identified. Spider mites are widely distributed and may transmit viruses.

Objective: To determine the role of insects and mites in the transmission of soybean diseases and use this information as an aid to control the diseases.

Research Approaches:

A. Use various mites and insects, especially aphids and leafhoppers, collected in virus-infected soybean fields, in transmission tests to determine if they are vectors of soybean viruses.

B. Determine virus movement and increase within the vector.

C. Determine the relationship of vector movement between and within fields to the spread and incidence of viruses.

D. Exclude certain suspected vectors from areas within fields of soybeans having virus problems to observe virus development and spread in the absence of insects and the effect of vector control on the incidence and spread of viruses.

Potential Benefits: Reduced yield losses from virus diseases; improved seed quality.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.1	.7	3 1/	2 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

LIFE HISTORIES OF SOYBEAN PATHOGENS AND LOSSES FROM SOYBEAN DISEASES

RPA 208-D (3*-20**)

Situation: Numerous plant pathogens are known to attack soybeans. Pathogens frequently appear in combination. The interrelationships are not fully understood. Information on life histories of pathogens as they relate to soybean diseases is essential for an efficient control program. Estimates of yield reductions have been made for bacterial pustule, target spot, cyst nematodes, and phytophthora rot. Yield reductions may range from slight to complete destruction. Additional pathogens are frequently recognized but estimates of yield reduction have not been made. Disease loss estimates have not been made with adequate consideration of other limitations on production, nor of the interaction of production level and economic factors. Reliability of estimates of losses in a small plot is much greater than estimates of total losses from soybean diseases on a nationwide basis.

Objective: To gain a more thorough understanding of pathogens attacking soybeans, their effects upon the efficiency of the soybean plant, and the nature and extent of losses due to soybean diseases.

Research Approaches:

A. Identify pathogens and determine host range and environmental factors favoring their development.

B. Study life cycles of pathogens to identify stages which offer good opportunities for control.

C. Study genetic and environmental variability of pathogens.

D. Use closely related resistant and susceptible soybean strains or chemical control to determine the nature and extent of losses caused by soybean diseases along, in combination, and under various environmental and management situations.

E. Develop effective inoculation techniques to facilitate studies of injury and control methods.

Potential Benefits: The benefits from this activity are related directly to those from breeding and management. The information obtained will facilitate and speed the gains obtained in the other activities and may prevent losses that would occur in the absence of the information.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.8	1.6	5 1/	3 1/
USDA	0.9		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

IDENTIFICATION AND CONTROL OF FOREIGN DISEASES THAT MAY DAMAGE SOYBEANS

RPA 208-E (4*-33**)

Situation: Many of the plant pathogens known to attack soybeans in Asia have not appeared in U.S. soybean-growing areas. The reaction of U.S. germ plasm to some of these pathogens is not known. A devastating disease such as a rust could cause losses of hundreds of millions of dollars per year.

Objective: To determine reaction of major U.S. soybean varieties and germ plasm to foreign disease organisms and to better understand the potential damage that could result from introduction of such soybean pathogens.

Research Approaches:

A. Screen U.S. varieties for reaction to pathogens in areas where diseases are now found.

B. Study nature of disease and its incitant in areas where it is a problem.

C. Initiate a breeding program in cooperation with foreign scientists, to develop resistant lines for U.S. areas where disease is most likely to be a problem.

D. Participate in the International Biological Program in order to obtain maximum effectiveness of international programs.

Potential Benefits: Minimize potential effects upon U.S. soybean production of introduction of new pathogens. Understanding a disease such as soybean rust and having resistant genotypes identified prior to introduction of the pathogen could prevent losses due to new diseases.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	0.1		2 1/	
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

THE INTERACTION OF DISEASES CAUSED BY ROOT AND/OR STEM INVADING PATHOGENS AND OTHER SOIL-RELATED FACTORS IN REDUCING SOYBEAN YIELDS

RPA 208-F (2*-8**)

Situation: Diseases caused by pathogens penetrating and/or affecting the host roots or base of the stem require additional research to ascertain the role of these diseases in limiting soybean productivity. In certain geographical areas, such diseases are recognized as limiting production and in other areas the problems may exist but are not recognized due to their "hidden" or subtle nature. For example, diseases such as charcoal rot, caused by *Macrophomina phaseoli*, and Pythium seedling disease have recently been recognized as problems in Arkansas; however, these problems have not been recognized in some other southern areas. It is believed that wide-spread increases in soybean productivity can be realized only if the subtle factors residing in the soil are studied in a comprehensive manner. The inter-relationships of root diseases and other soil related factors such as beneficial microorganisms (Rhizobia and mycorrhizae), nutrient absorption, plant parasitic nematodes, physical and chemical soil characteristics, herbicides, etc., are critical to understanding and solving the problems of substandard soybean yields. The tactical research problem in this area resides in the overlapping of scientific disciplines.

Objective: To integrate the related scientific disciplines and their respective research personnel in order to research salient soil factors which affect soybean production (diseases, symbiotic relationships, mineral absorption, plant parasitic nematodes, physiology, and physical and chemical effects).

Research Approaches:

A. Quantify the factors present in soil which influence soybean yields.

B. Determine interrelationships among soil inhabiting organisms affecting soybean production.

C. Study the interrelationships of soil factors on root exudations.

D. Study the interaction between physical and biological factors in soil and their effect on soybean yields.

Potential Benefits: The overall aim of this research is to increase soybean yields through understanding the subtle factors residing in soil which effect plant growth. This information would be useful to plant breeders in designing phenotypes with favorable characteristics.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	2.9	1.4	7 1/	3 1/
USDA	.9		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

PRACTICES FOR CONTROLLING WEEDS IN SOYBEANS WITH EMPHASIS ON INTEGRATED SYSTEMS OF CONTROL

RPA 209-A (1*-1**)

Situation: For many years, most research for weed control in soybeans in the Southern states has been concerned primarily with evaluation of candidate herbicides. From these many experiments have emerged over a dozen herbicides for incorporated preemergence, surface preemergence, early postemergence, or directed postemergence treatments on soybeans. As herbicides were increasingly used, the uncontrolled spectrum of weeds changed in many localities from the more easily controlled annuals to species such as Texas panicum, Johnson grass, cocklebur, sicklepod and Florida beggarweed. A review of previous research (including the effectiveness of vigorous, precise, and timely cultivation) leads one to the belief that we now have the diverse tools needed for effectively controlling most of the weeds in soybeans. What is lacking is research designed to integrate these diverse tools into excellent sytems of weed control. For example, the herbicide chloroxuron, although limited in usefulness in controlling larger weeds, functions quite well if applied when both the soybeans and weeds are very small. A timely application permits the development of a height differential between the weeds and beans and this differential is absolutely necessary for the effective utilization of directed postemergence treatments. Integrated studies on systems of weed control can provide relatively rapid answers to many of the most vexing weed problems facing soybean farmers. The probability for productive experimentation is very high since previous research has already firmly established the usefulness of the components to be employed in the integrated systems.

Objective: To develop safe but effective systems of controlling weeds in soybeans utilizing (a) mechanical, (b) chemical, and (c) chemical plus mechanical methods.

Research Approaches:

A. Develop integrated systems of weed control involving:
(1) the most effective available mechanical means,
(2) the most effective herbicide treatments, and
(3) various combinations of chemical and cultural methods.
The studies should also include (1) weedy checks to measure soybean yield loss from weeds and (2) data on costs of the treatments used.

B. Determine differential responses of varieties, including different row spacings, to effective systems of weed control.

C. Investigate interactions between systems of weed control and such other factors as quality of seed planted, quality of seed produced (including lipid analyses), other pesticides, carriers (including liquid fertilizers), diseases of soybeans, rainfall, temperature, and soil types.

D. Study cropping sequences (either continuous or in rotation depending on area involved) to determine the long range effects of various weed control systems and crop sequences on the weed population.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

E. To provide a continuum of the most promising herbicide components for integrated control systems, primary and secondary evaluation studies should be continued at three or four key locations but discontinued at all others except when specific data is critically needed to help secure a new registered use or to formulate recommendations.

F. Determine if undesirable levels of herbicide remain in the soil following various systems of weed control.

Potential Benefits: The extension worker and soybean farmer will have available urgently needed information on effective systems of weed control which utilize the best current methods (whether herbicide or mechanical) for our most difficult problem weeds. Data on yield losses caused by weeds will enable farmers to more readily justify the increased expenditures required for timely and intensive weed control methods.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	5.2	3.2	7 1/	5 1/
USDA	1.0	0.7		X

1/ Number of states listing this category as the first area of needed funding.

COMPETITION OF WEEDS WITH SOYBEANS

RPA 209-B (4*-16**)

Situation: To aid in developing the most effective weed control procedures, we need further basic information on the ecological relationships between the most difficult weeds and soybeans. For example, one sees a soybean field covered with cocklebur at harvest time. When did these weeds emerge? Early? Midseason? Late? What densities of weeds are required to reduce the yields of soybeans? How long must soybeans be kept weedfree to minimize or avoid adverse effects from weed competition? Conversely, how long can weeds compete with soybeans before yield is reduced? Competition studies are extremely limited. Data from Delaware indicate that weedfree maintenance for 6-8 weeks enabled soybeans to successfully compete with morningglories. We do not know what weedfree intervals are required to avoid yield reductions from our most troublesome grasses and broadleaf weeds in the Southern states. Nor do we know how row spacings affect these critical intervals. Therefore, competition research involving our major problem weeds is critically needed, Chances for productive experiments are outstanding.

Objective: To define competitive relationships between soybeans and weeds and to relate these relationships to weed control technology.

Research Approaches:

A. Determine the periods of weedfree maintenance required to avoid yield losses from competition with specific weeds.

B. Determine the periods of weed competition required to reduce the yield of soybeans.

C. Study the response of different varieties of soybeans to specified periods of weedfree maintenance and weed competition.

D. Determine how different row spacings affect the competitive relationships between soybeans and weeds.

E. Determine what density (number per square feet or running foot of row) of the most troublesome weeds is required to reduce the yields of soybeans.

Potential Benefits: By pinpointing the critical periods of competition, we will know how long after planting weed control must be maintained for normal yields and also when the crop itself begins to effectively suppress the weeds. The emergence dates of the weeds causing the most damage will be pinpointed. The role of closely spaced rows in increasing the capacity of the soybean plant will be clarified. The results will lead to improved weed control practices with less cost to the soybean farmer.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYS
SAES	2.1	.9	3 1/	5 1/
USDA	3	5	X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

CONVENTIONAL VERSUS MINIMUM TILLAGE METHODS OF WEED CONTROL IN SOYBEAN PRODUCTION

RPA 209-C (3*-22**)

Situation: In areas outside the Delta, soybean production with minimum tillage is increasing in importance. Although its soil-conserving features are especially adaptable to the rolling terrain of the Piedmont Plateau and mountain areas, minimum tillage production of soybeans is also practiced to some extent in the Coastal Plain. It is not well adapted, however, to the very heavy soils and high degree of mono-culture now used in producing soybeans in the Delta. Because of the potential of minimum tillage methods on most of our soil types, this type of culture needs more investigation in the future than it has received in the past. Chances for productive research are rated good.

Objective: To develop improved systems for production of soybeans with minimum tillage and to compare the economics of these systems with conventional production methods.

Research Approaches:

A. Refine procedures for minimum-tillage production of soybeans in the Coastal Plain and Upland areas of the Southern states.

B. Compare minimum-tillage with conventional production techniques with respect to weeds controlled, changes in the weed spectrum, soybean yield and quality, and relative economic benefits from the two systems of production.

Potential Benefits: The relative merits of minimum tillage and conventional methods of production will be clarified and each soybean farmer will be able to choose the system best fitted to his needs.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.0	2.4	9 1/	3 1/
USDA		1.0		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

PHYSIOLOGICAL, BIOLOGICAL, AND GENETIC RESPONSES OF SOYBEANS TO WEED CONTROL MATERIALS AND METHODS

RPA 209-D (2*-11**)

Situation: At the present time, due to the critical severity of weed problems facing the soybean farmer, primary attention should be focused on field plot research designed to alleviate the yield reductions and harvesting problems created by uncontrolled weeds in soybean fields. However, while the present technology is being integrated into effective weed control systems, some experimentation should be conducted on physiological, biological, and genetic responses of soybeans to control methods. As the more pressing weed problems are resolved (or more scientists are employed) more effort could be diverted to expanding studies of a very fundamental nature. Perhaps it is appropriate also to consider a unified national approach to the research in this proposal (and other related research) since these problems of a fundamental nature are common to soybeans wherever they are grown.

Research Approaches:

A. Determine the effects of herbicides (used for controlling weeds in soybeans) on various metabolic systems within the soybean plant.

B. Determine physiological and anatomical characteristics of specific weeds and evaluate these characteristics as a means of regulating growth of weeds.

C. Determine genetic variability in tolerance to herbicides among soybean genotypes, and the feasibility of improving weed control by breeding soybean varieties with increased herbicide tolerance.

D. Develop biological and biochemical methods for controlling weeds in soybeans (for example, insects and diseases as control agents; use of plant exudates; destruction of weed seed dormancy).

Potential Benefits: This basic research would pave the way toward new and innovative methods of weed control. When breakthroughs occur with other crops and in other geographical areas, they can be adapted to soybean production with minimum manpower. Possibly, the most concentrated research in this work plan should be that which is associated with the soybean plant. This approach, accompanied by adaptation and refinement of techniques discovered with other crops and geographical areas, should provide for substantial forward momentum with minimum SMY.

Current and Recommended Research Effort:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.6	.6	4 1/	2 1/
USDA	.1		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

IMPROVEMENT OF BIOLOGICAL EFFICIENCY, MECHANIZATION, AND PRODUCTION SYSTEMS

RPA 307, 308, and 309

Goal III in the National Program of Research for Agriculture is concerned with producing an adequate supply of farm and forest products by decreasing real production costs. The improvement of the soybean through a program designed to increase the crop's biological efficiency would be a major step forward. Integrated and improved pest management through breeding and selection of cultivars possessing resistance to insects and diseases or greater vigor in the competitive realm with weeds must be considered concurrently. Biologically efficient plants cannot be obtained if they cannot resist or tolerate attack from diseases, nematodes or insects.

The Southern Region is ideally suited to expanded soybean production. It has a climate suitable for producing two crops per acre per year. Double cropping cultivars are needed as well as the technology to produce them.

The Coastal Plains of the South and the heavy clays of the Piedmont regions are subjected to climatic variations that result in drought stresses on an annual basis. Several million acres of potential soybean acres lie beneath the heavily forested flatwoods regions. These regions have periodic water stress as well as a water excess problem. The physiology of water movement through the plant and the physics of water movement through the soil offers many researchable problems in the South. Solving the problems related to moisture stress in soybeans and of subsequent yield depressions will stabilize annual production. Such stabilization will increase the South's total ability to provide its needed supply of oil and protein or enter into commodity exchange with other regions.

The relatively infertile soils of the region have been utilized profitably for the production of soybeans; however, soybean nutrition has been enhanced by proper fertilization. Micronutrient problems occur with increasing frequency. The addition of lime is essential but the pH range of the soil has been found to be relatively narrow and limiting.

Quality, high vigor seed for production of subsequent crops has been difficult to maintain. Agronomists working within RPA 307 must work closely with engineers in the harvesting and storage phases of the crop (RPA 308). Before the region can reach its potential on-farm storage and drying must be developed. Mechanization developed in the Midwest will not totally transfer to the South.

Development of a system of soybean production can be approached via two or more avenues. RPA 309 can approach via the conventional putting together of the research knowledge gained through RPAs 207, 208, 209, 307, and 308 in field experiments. This approach will provide many of the short range answers. The development of computerized mathematical models based on similar data, with the addition of plant behavioral data, economic and other inputs, will lead to programs that will optimize returns per acre, lead the way to new areas of production (either new acres or double cropping) or point to areas of additional research needs.

PLANT CHARACTERISTICS AND MANAGEMENT PRACTICES

RPA 307-A (6*-8**)

Situation: Soybean varieties currently available have the genetic potential for producing 70 to 80 bushels per acre, or approximately three times the state average yield in each of the southern states. Available moisture during the fruiting period is a limiting factor in many of the years. Soil conditions which limit root penetration or moisture penetration are also factors. Differences in soybean genotypes do exist. An understanding of the physiological mechanisms involved could aid in recognizing differences in soybean genotype interactions with moisture conditions. Reaction of soybean to soil conditions might also influence root development.

Objective: To determine the attributes which permit soybeans to make most efficient use of water and nutrients in producing maximum seed yields; to identify management practices which will result in more uniform stands, deeper root penetration, and maximum response to available water and nutrients.

Research Approaches:

A. Evaluate plant characteristics to identify those which contribute to most efficient water and nutrient use in producing high seed yields at different levels of water and nutrient availability, including extremes--excesses or deficiencies.

B. Evaluate genotype interactions under various moisture levels and soil types.

C. Compare methods of seedbed preparation, planting, tillage, including minimum tillage as to effects on traffic pan development, moisture stress, physical soil properties, and soybean seed yield.

D. Determine soil moisture holding characteristics to predict optimum time of application of supplemental irrigation.

E. Coordinate with RPA 208-A, RPA 209-A, and RPA 105.

Potential Benefits: Reduce cost of production by more efficient use of water and nutrients and giving greater stability to production.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	4.6	6.6	5 1/	8 1/
USDA	.7		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

NUTRIENT RELATIONSHIPS AND FERTILIZATION OF SOYBEANS

RPA 307-B (6*-13**)

Situation: There is a need for more refinement in field calibration of soil test data as measured by plant response. Much expression of failure of soybeans to direct fertilization may be more correctly a failure to understand or identify the most limiting factor. A large area of potential soybean acreage exists in the flatwood soils which are extremely acid. Aluminum toxicity or other undetermined factors may limit root development and thus contribute to drouth stress, reduced nutrient uptake, and lower yields.

Objective: To refine the calibration of soil testing ratings for P, K, and lime requirements on a wider range of soils, including flatwood soils having poor internal drainage. To study the significance of strongly acid subsoils and identify soybean genotypes more tolerant of these conditions.

Research Approaches:

A. Field experiments to calibrate chemical soil test ratings on a wide range of soil types, including wet-natured and irrigated soils.

B. Study effects of acid subsoils on root development under field conditions and investigate genotype differences in root development under these conditions.

Potential Benefits: More efficient use of lime and fertilizer would lead to lowered cost of production. Efficient operation of flatwood soils could provide three to five million acres of productive soybean land.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.9	2.7	8 1/	4 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

MORE EFFICIENT ENERGY STORAGE BY SOYBEANS

RPA 307-C (4*-10**)

Situation: Higher soybean yields depend upon more efficient utilization of photosynthates, especially during the period from flowering to maturity. Such utilization might involve increased production of photosynthates as well as stimulating the movement of their site of production to their site of utilization. Genetic expression of assimilate utilization may be altered by various chemical treatments or the type and rate of nutrients applied.

Objective: To evaluate soybean genotypes and the effects of chemical treatments of various genotypes for nutrient, water, and assimilate utilization.

Research Approaches:

A. Study several enzyme systems associated with nutrient and assimilate utilization.

B. Determine the effects of growth regulators on CO_2 assimilation and translocation.

C. Evaluation of physiological processes and enzymes involved in fixing carbon dioxide from atmosphere into organic plant materials.

D. Screen soybean genotypes for assimilation utilization and accumulation.

E. Coordinate with research in related areas.

Potential Benefits: Increased soybean yields and more efficient production.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	2.8	1.6	5 1/	2 1/
USDA	0.2	1.0		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

NITROGEN NUTRITION AND UTILIZATION

RPA 307-D (5*-12**)

Situation: Soybeans contain approximately 7% elemental nitrogen. To obtain high seed yields, it is necessary to incorporate nitrogen from the soil and/or through nitrogen-fixing processes into the plant. An efficient assimilation of the nitrogenous constituents is necessary for maintenance of metabolic functions in the plant. To obtain higher levels of protein production per acre more information concerning the incorporation of nitrogen from different sources is necessary.

Objective: To develop methods of obtaining and utilizing nitrogen for increased seed yields.

Research Approaches:

A. Determine and characterize the metabolic steps that may limit nitrogen fixation.

B. Evaluate strains of nodulating bacteria in relation to efficiency of nitrogen-fixation and interactions with soybean genotypes and soil conditions.

C. Ascertain the interactions related to nitrogen-fixation and nitrate utilization.

D. Investigate the interactions of different sources of nitrogen, organic and inorganic, and their influences on nitrogen-fixation potentials.

E. Coordinate with interrelated research.

Character of Potential Benefits: Increased soybean protein production and seed yields.

Magnitude of Potential Benefits: Increased protein with higher yields resulting in increased dollar values from soybeans.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.0	1.1	5 1/	1 1/
USDA		.8		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

ROOT-SOIL RELATIONSHIPS

RPA 307-E (3*-4**)

Situation: Physical impedance to root penetration below the plow layers is a widespread condition, especially on soils in which kaolinitic clay dominates, such as found in many southeastern soils. These subsoil "hardpans" are largely traffic pans but some are genetic in origin, such as the fragipans. Under present cultural conditions, soybeans utilize soil moisture from only the surface 7 to 8 inches in many fields. Under these conditions drouth stress occurs very readily.

Objective: To determine practical means of improving the root environment of soybean plants, so as to increase its efficiency in water and nutrient uptake.

Research Approaches:

A. Investigate practical methods of reducing physical impedance to root development in the subsoil.

B. Investigate microbial activities in the rhizosphere and effects of pesticides on root functions.

C. Determine if significant genetic differences exist in ability of roots of different genotypes to penetrate subsoils of varying densities.

Potential Benefits: Stability in soybean yields.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.4	3.4	5 1/	5 1/
USDA	0.7	0.2		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

GENETICS AND BREEDING FOR HIGHER SEED YIELDS

RPA 307-F (2*-2**)

Situation: Seed yield of soybean varieties presently grown in the southern U.S. averages nearly 60% greater than the best producers of the introduced material. This increased yield results from improvements in disease resistance, lodging resistance, and more efficient utilization of water and nutrients. Much more can be accomplished in this field. Research has barely touched on the physiological responses, energy, and water or nutrient use. Complete utilization of information on basic physiological processes to improve seed yield and seed quality depends in a large part on research in genetics and breeding.

Objective: To develop through breeding higher yielding soybean varieties tolerant to environmental hazards which have desired market qualities.

Research Approaches:

A. Identify factors which limit soybean yields and determine source of resistance.

B. Determine the inheritance of basic physiological differences.

C. Investigate the influence of protein and oil content and amino and fatty acid balance on seed yield, and incorporate desired qualities into productive varieties.

D. Develop more efficient genetic combinations with multiple disease and nematode resistance, tolerance to pesticides, and responsiveness and efficiency in utilization of water, light, and nutrients.

E. Identify the physiological characteristics that distinguish susceptible and resistant responses.

F. Develop varieties with maturity, stature and other characters suitable for multiple cropping.

Potential Benefits: Improving yield potential and reducing hazards to production would result in more profitable soybean production. Productive varieties having higher protein content could expand markets for soybeans.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	10.5	4.3	7 1/	6 1/
USDA	6.5	1.0	X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

GROWTH REGULATORS FOR SOYBEANS

RPA 307-G (7*-15**)

Situation: The purpose of using growth regulating chemicals is to control some of the physiological processes that aid in the development of flowering and pod filling. These physiological processes must be regulated in such a manner as to increase seed production while controlling vegetative growth. Such chemicals may be useful by diverting some of the energy normally used for vegetative growth into seed production, as well as increase energy utilization efficiency.

Objective: To evaluate physiological and morphological responses of soybeans to various growth regulator treatments and determine which treatments have potential for increasing soybean yields.

Research Approaches:

A. Screen chemicals to determine their effects on soybean yields.

B. Investigate the effectiveness of different methods of application.

C. Identify physiological systems which, if stimulated or depressed, might favor pod and seed production.

D. Evaluate the effects of growth regulators on seed quality and viability.

E. Coordinate with research in related areas.

F. Investigate the effects of potentially useful growth regulators on specific metabolic systems.

Potential Benefits: Increase seed production by modifying genetic expression of physiological processes in a given environmental condition. A chemical method of broadening the base of genetic expression for seed production. More efficient soybean production.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.3	3.0	6 1/	0
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

EVALUATION OF LANDS SUITABLE FOR EXPANDED ACREAGE

RPA 307-H (7*-18**)

Situation: A potential for considerable further expansion of soybean acreage in the South exists, but at present it is taking place without planning and without factual information on soil capabilities for this crop. It is believed that the following types of land constitute a largely unexploited asset for soybean production in this region: (1) "Flatwood" soils of the Lower Coastal Plains, (2) bottomlands and low terraces along many of the river systems, much of which is poorly drained and subject to spring overflows, and (3) relatively level uplands with restricted internal drainage. Much of this acreage at present either is in poor quality low-yielding woodland or unimproved pastures.

With declining cotton and corn acreages, many landowners will "try" soybeans on these upland soils. Misleadingly, it has been said that any soil that will grow cotton or corn is adapted to soybeans. The soybean is not as drouth tolerant as cotton during the fruiting period and in this region has a peak moisture requirement later than corn.

Objective: To establish capability ratings for soybeans on these lands and approximate costs of needed improvements such as drainage and major fertility requirements.

Research Approaches:

A. Obtain yield data on the major soil types and/or soil associations under defined management systems in the areas where suitable soils exist and are being brought into soybean production.

B. Accumulate data on fertility requirements of new lands suitable for soybean production.

C. Obtain information from innovative land owners and loan agencies on costs of clearing and draining woodlands which offer potential for this crop.

D. Compile existing data by soil types and calculate probability of profitable soybean yields on drouthy upland soils being released from corn and cotton production.

E. Coordinate with research in RPAs 307-A, -B, and-E, 308 and 309.

Potential Benefits: Increased acreage and production of soybeans in the region by utilizing low-income producing lands suitable for the crop and avoiding further depletion of soil resources through erosion of lands released from cotton and corn, some of which is not suitable for soybeans.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.3	2.0	4 1/	3 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

WATER RELATIONS IN SOYBEANS

RPA 307-I (1*-3**)

Situation: Water relations and physiological processes in plants involve numerous interactions. Alterations in the external environment influence the plant's internal environment, and the internal water status of a plant influences its effective photosynthesis and assimilation. From field performance and some laboratory tests, differences in soybean selection do exist; therefore, an understanding of the physiological mechanisms involved and methods of recognizing differences in soybean selections, could aid in developing cultural practices best adapted to specific genotypes.

Objective: To determine means of improving soybean performance in uptake and utilization of water and nutrients.

Research Approaches:

A. Develop methods for measuring the plant water status relative to soil moisture.

B. Evaluate physiological responses at different plant water potentials relative to growth and development.

C. Evaluate cultivars for difference in susceptibility to stress and ascertain physiological nature of resistance.

D. Identify the limits of tolerance of the soybean plant to several environmental conditions that affect plant water status.

E. Develop and evaluate more efficient methods of utilizing the required plant nutrients and available water supply.

Character of Potential Benefits: More efficient use of environmental resources in increasing seed yields.

Magnitude of Potential Benefits: Increase seed production in areas presently considered to be limited by available water supply resulting in millions of dollars in increased production.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.9	2.4	4 1/	2 1/
USDA	.4	.2		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

PHYSIOLOGICAL NATURE OF RESISTANCE TO GROWTH AND DEVELOPMENT HAZARDS

RPA 307-J (8*-17**)

Situation: Some soybean cultivars are recognized as being either resistant or susceptible to growth and developmental hazards. Although such cultivars are recognized, the nature of the physiological responses to resistance and susceptibility are not known. Such information would assist plant breeders in incorporating resistant germ plasm into soybean varieties.

Objective: To ascertain the physiological, chemical and anatomical nature of plant resistance responses to hazards during growth and development.

Research Approaches:

A. Identify and evaluate the degree and types of hazards to soybean production.

B. Selection of susceptibility and tolerance in soybean germ plasm to specific growth and development hazards.

C. Identify the chemical and/or physiological characteristics that distinguish susceptible and resistant responses.

D. Elucidate the possible interactions of anatomical structures to physiological resistance responses.

Character of Potential Benefits: Broaden the base of adaptability of soybean varieties and increase the understanding of plant interactions in adverse environments. This could also reduce the time required in the future to develop new varieties with broad base resistance.

Magnitude of Potential Benefits: Reduce yield losses due to adverse environmental conditions which could mean millions of dollars in increased production.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.1	1.0	3 1/	1 1/
USDA	.2		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

SEED QUALITY

RPA 307-K (9*-20**)

Situation: Seed viability and germination vigor declines with age. An evaluation of the characteristics and properties of soybean seed influenced by production practices could result in the production of a better quality seed for planting and processing.

Objective: To identify factors involved in improving the overall quality of soybean seed.

Research Approaches:

A. Investigate the physiological nature of the changes that occur during the aging process in the seed.

B. Identify properties of seed that contribute to rapid seed germination and seedling vigor.

C. Determine environmental factors and physiological interactions associated with seed viability.

D. Evaluate the properties involved in soybean seed oil and protein deterioration.

E. Identify properties within the seed that contribute to flavor formation in seed products.

F. Coordinate with related research.

Character of Potential Benefits: Improved seed quality could lead to uniform germination and seedling vigor and thereby produce seedlings that are more competitive with other plant species. Improved seed quality could also provide more desirable feed and food products from soybeans.

Magnitude of Potential Benefits: Reduced losses caused by poor seed quality and thereby increase the value of soybean products. This could amount to several million dollars.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	3.7	3.1	5 1/	3 1/
USDA	0.5		X	

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

SOYBEAN PRODUCTION EFFICIENCY

RPA 308 (1*-19**)

Situation: In spite of soybean's prominence, information on proper harvesting, handling and farm processing is nearly non-existent in the Southern Region. Much of the equipment currently used was designed for other crops. Southern environments, production practices and soybean types create problems of differing magnitude from those of the Midwest.

Objective: To improve equipment for harvesting, handling, and farm processing soybeans.

Research Approaches:

A. Adapt or develop methods and equipment to increase harvest efficiency and decrease handling and processing damage.

B. Place emphasis on harvesting equipment and methods for double cropping and flotation gear for harvesting on wet lands.

C. Develop techniques and equipment for land preparation, planting, cultivation and pest control that would expedite efficient harvest.

Potential Benefits: Increased harvested yields or decreased harvest losses on each acre produced and increased acres in production through use of double cropping.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.8	2.9	6 1/	3 1/
USDA		6.0		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

SYSTEMS ANALYSIS FOR SOYBEAN PRODUCTION

RPA 309 (1*-24**)

Situation: Many factors influence the yield of the soybean crop. Included are the genetics, physiology and morphology of the plant, aerial and subterranean environments, interaction with other organisms and economics. Pests, fertility, planting, harvesting, storage, as well as those listed above must be accounted for in managerial decisions. Data are available in bits and pieces that can be pulled together to form a whole in a simulated production model. Such a methematical model can be used to develop production schemes and to point to gaps in our research data base.

Objective: To combine that set of production practices, capital investments, labor availability with the factors of environment and of plant growth into a production system that will optimize income.

Research Approaches:

A. Collect research data and determine interactions.

B. Using known resources, develop and test models and systems of soybean production.

C. Identify research needs to develop systems to maximize efficiency.

Potential Benefits: Maximize production through an understanding of production limitations and plant response to management.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.6	2.3	4 1/	2 1/
USDA	0.2	1.2		X

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

UTILIZATION AND MARKETING

RPA 406, 407, 501, and 504

The utilization and marketing of soybeans in the South does not differ to a great extent from that of the Midwest. Excellent facilities for utilization research exist, for example, in the Department of Animal Science at North Carolina State University, Raleigh, North Carolina, and at the Richard B. Russell Agricultural Research Center, Athens, Georgia. Innovative research must be encouraged; however, the development of a large research effort could easily be duplicative with that of the Regional Utilization Laboratory located in Peoria, Illinois.

Continued increased production of soybeans in the South must of necessity result in the development of marketing alternatives. The pricing problems associated with forced harvest time sales due to the lack of storage facilities result in severe losses of income. Southern farmers do not have well developed markets for soybeans or the field grains. Market development research for intra- and inter-regional as well as foreign trade will bring new income into the region. Marketing research should be directed to new innovative concepts and towards solving specific regional problems.

NEW AND IMPROVED SOYBEAN PROTEIN FOOD PRODUCTS

RPA 406-A (1*-25**)

Situation: Over the past few years, there has been considerable research and development effort by USDA and industry directed toward the production of soybean protein foods. Interest in high protein foods stems from recognized protein deficiencies amongst certain populations in developing countries, and the need for low-cost protein foods for the domestic and export markets. Possible outlets for these foods are for foreign aid programs, institutional foods, school lunch programs, vegetarian diets, and exports. Examples of such product developments are:

1. Corn-soy-milk (CSM) for AID.
2. Wheat-soy-blend (WSB) for AID.
3. Fortified macaroni (20% protein).
4. Extruder-cooked full-fat soyflour.
5. Protein beverages (Saci, Puma, etc., produced in South America by American companied).
6. Fibrous meat-like soy protein products.
7. Textured soybean protein products.
8. Protein beverage powder.
9. Soy milk products.
10. Multipurpose food based on toasted soyflour, vitamins, minerals and seasoning.

Currently, most USDA research on soybean protein foods is carried out by the ARS Northern Marketing and Nutrition Research Division in Peoria, Illinois (13 SMY). However, basic nutritional studies involving metabolic inhibitors, amino acid availability, and mineral metabolism are being conducted at SAES (5 active projects).

Additional research is needed on nutrient analysis, digestibility, and improvement of nutritive value. For the Southern Region, studies are needed on supplementing cornmeal with soybean protein for food donations, institutional foods, and school lunch programs in the South.

Objective: To develop more nutritious and more acceptable soybean protein food products.

Research Approaches:

A. Studies on the color, flavor and texture of soybean protein food products.

B. Relationship of composition to quality of food products.

C. Enzymatic and other methods for improvement of acceptability and nutritive value of protein foods.

D. Development of new and improved low-cost protein foods for the domestic and export market.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

Potential Benefit: Foods based on full-fat or defatted soyflour represent the lowest priced source of high-quality protein for human consumption. Such foods have great potential for meeting the needs for more dietary protein both at home and abroad. It is well known that new foods must be acceptable to people before they will be consumed. Creating this acceptability is a problem for food scientists and technologists.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	1.0	3.7	4 1/	3 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

FOOD USE OF SOYBEAN OIL

RPA 406-B (2*-30**)

Situation: The major problem in the utilization of soybean oil in margarine, shortening, and salad and cooking oils is flavor stability, especially on storage and deep fat frying. The flavor problem stems largely from the presence of 5 to 8 percent linolenate in the oil. Linolenate is relatively unstable, especially in the presence of oxygen (air) and at elevated temperatures, and breaks down to give products causing off-flavor, which are variously described as fishy, painty or grassy. Although linolenate is the major factor in the flavor problem of soybean oil, other components appear to be involved. Research on this problem as well as on related food use problems, such as reduction of water pollution by soybean oil refineries, is carried out by the Northern Marketing and Nutrition Research Division, ARS, and by industry, with some work from time to time at Rutgers University. Several processors are experiencing difficulty in controlling water pollution from oil refineries, and research is designed to furnish needed information on removal of contaminants. However, more attention needs to be given to pollution problems involved in processing soybean oil in the Southern Region.

Objectives: To devise methods of chemically treating soybean oil to provide a more stable oil for use in cooking and salad oil and as a liquid oil for margarine; and to develop procedures for removing pollutants from water effluents at oil refineries.

Research Approaches:

A. Develop improved catalytic and chemical methods to selectively remove the linolenate component from refined soybean oil.

B. Develop a lower-cost process for removal of soaps from alkali-refined soybean oil by use of ion-exchange resins.

C. Develop processes for removal of objectionable flavors and other undesirable factors from soybean oil food products.

Potential Benefits: In the export market, soybean oil must compete with more stable vegetable oils obtained from sunflower seed, peanuts, and cottonseed. Economical processes for producing a high-quality soybean oil for food use should improve the competitive position of soybeans in the European market. High quality liquid vegetable oils are demanded in the domestic market to meet nutritional and health requirements.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.1	.3	1 1/	1 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

NEW AND IMPROVED INDUSTRIAL PRODUCTS FROM SOYBEAN OIL

RPA 407-A (2*-31**)

Situation: About 6 percent of the 6.2 billion pounds of soybean oil consumed domestically in 1971 went into industrial products, such as paints, plastics, resins, chemicals and soaps. Utilization research has resulted in the development of such products as epoxidized soybean oil, dimer acids, and polyamide resins. In general such products compete with similar chemicals from petroleum, which is usually a more economical source of raw material. Opportunities do exist for industrial products when specific properties are required, which are more economically obtained from soybean oil than from other available raw material. This is especially true of such soybean oil byproducts as foots obtained from refining the crude oil. Research in this area of soybean oil utilization is carried out by the Northern Marketing and Nutrition Research Division, ARS, and by industry.

Objective: To develop new and improved industrial products from soybean oil by chemical modification of the oil.

Research Approaches:

A. Develop new plastics, resins, coatings, lubricants, and other new and improved non-food products or process based on chemical modification of soybean oil.

B. Evaluate experimental products and processes for specific industrial applications.

Potential Benefits: New outlets for soybean oil in non-food uses should help stabilize prices by diversification of markets.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	0	0	1 1/	
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

FEED USE OF SOYBEAN MEAL

RPA 407-B (1*-31**)

Situation: For computer formulation of feeds, information must be available on the nutritional requirements of the animal involved, cost of ingredients, and nutrient composition of feed products available for use. We know least about the last. The composition of soybean meal is known to vary, but the extent of variation is not known. Also, more precise data is needed on digestibility or availability of nutrients in the meal for livestock and poultry. Specific data is essential if maximum benefit is to be received from computer control of feed formulation. Insofar as is known, no research is being carried out by USDA on this problem. Some work (3 projects) on nutrient availability is being carried out by SAES's.

For several years, research has been conducted by industry and at the North Carolina AES on replacing milk in calf milk replacers with soyflour. Part of the milk protein may be replaced, and calf milk replacers containing a combination of milk and soy protein are commercially available. A product containing all soy protein is still unsuccessful, because the growth rate of calves is decreased as the level of soyflour is increased. Because of the increasing price of milk, there is an upswing in the interest of using more soy protein in calf milk replacers. Considerable basic and applied information has been published by scientists at North Carolina State University on the use of soyflour in calf milk replacers over the past few years. These publications indicate that sufficient background information is available for improving and reducing the cost of calf milk replacers based on modified soyflour as a replacement for milk.

Considerable information is available on the processing and feeding value of whole soybeans for swine and poultry. However, additional studies are needed to provide farmers with information on feasible and economical methods for cooking and grinding, or otherwise processing, low-value soybean splits and screenings to produce a high-quality supplement for indigenous feedstuffs.

Objective: To provide nutrient data and new and improved soybean feed products for use in lowering the production cost of livestock and poultry.

Research Approaches:

A. Conduct nutrient analysis on soybean meal from several varieties produced at several locations and by several processes to determine the effect of genetic, location and processing variables on nutrient content.

B. Determine the availability or digestibility of nutrients for species of livestock and poultry at different stages of growth or maintenance conditions.

C. Conduct basic and applied studies directed toward the development of a calf milk replacer in which the protein is derived from an economic source of modified soyflour.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

D. Relate processing variables in the preparation of full-fat soybean meal to feeding value in the production of livestock and poultry in the South.

Potential Benefits: More efficient use of nutrients based on actual composition of soybean meal and availability to the animal will permit increased feed efficiency in the production of livestock and poultry. A lower-cost calf milk replacer will provide savings in the production of veal and beef, which may be passed on to the consumer. Cooking soybean splits and other screenings offers an opportunity for the Southern farmer to supplement indigenous feedstuffs with a high-energy, high-protein product to reduce feed costs.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.2	.5	1 1/	1 1/
USDA				X

1/ Number of states listing this category as the first area of needed funding.

IMPROVEMENT OF GRADES AND STANDARDS

RPA 501 (1*-26**)

Situation: The lack in uniformity in grading and moisture determination for soybeans are problems in marketing. There is a need for improving the equipment, techniques, and sampling procedures to more fully reflect the value of soybeans. Presently, U. S. official grades are determined by test weight per bushel, moisture, splits, damaged kernels, and foreign materials. A new system for determining oil and meal (protein) content of soybeans is under study. This system of grading and buying should improve pricing accuracy at the point of first sale. While accuracy in grading is a responsibility of assigned regulatory agencies, economic research can identify the weak points in the grading system and suggest more useful types of information to improve the system.

Objective: To determine improvements needed in the grading of soybeans to more accurately reflect the value in marketing and in utilization.

Research Approaches:

A. To determine the quality factors which are most useful in reflecting the value of soybeans, including those presently in use, as well as potential measures of quality which appear to offer increased accuracy in grading.

B. To obtain from processors an evaluation of the requirements for an effective grading system which will furnish them a better basis for determining the output of products from soybeans. This approach might include an identification of soybean varieties which possess the most desirable processing characteristics and indicate needed improvements in soybean varieties to assure competitiveness with beans from other areas outside the Southern region.

C. To investigate methods of communicating processor needs relative to grades or quality of soybeans to producers in such manners that production decisions can be mutually beneficial to growers and processors.

D. To suggest to other areas of research (equipment manufacturers, oilseed chemists, etc.) the type of data needed to effectively grade and price soybeans.

Potential Benefits: Improved and more accurate grading to reflect the value of soybeans should benefit the producers of high quality beans for their efforts and penalize the producer of lower quality beans. The major benefit of an improved grading system, therefore, should be to channel soybean production toward a more desirable product with benefits to both the producer and processor of this product.

* Priority within specific RPA.
** Priority as measured overall RPA subgroups.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.2	.5	2 1/	1 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

PHYSICAL EFFICIENCY IN MARKETING SOYBEANS

RPA 504-A (1*-29**)

Situation: Farm storage is one marketing alternative available to producers who desire to hold soybeans after harvest for sale at a later time. Before selecting this alternative, the producer should be satisfied that the storage operation can be reasonably expected to be a profitable enterprise. A knowledge of soybean price behavior as well as other marketing costs and risks should be considered in this decision. The costs of alternative marketing facilities available to the producer must be evaluated. Data are needed on capital investment in storage facilities of varying capacities as well as the expected fixed and variable costs associated with maintaining and operating farm storage facilities. Limited research data are available for specific production areas on the costs and returns from farm storage of soybeans. Additional research on this problem under different production and marketing situations would be useful.

Objective: To determine the economic feasibility of farm storage of soybeans as an alternative marketing technique for areas in the Southern region.

Research Approaches:

A. To obtain cost of farm storage equipment from manufacturers and other sources for varying storage capacity, including transportation and erection costs at selected central point.

B. Determine costs of operation of facilities, including all fixed and variable costs.

C. Determine the profitability of farm storage by applying a series of soybean prices against storage costs for different lengths of storage periods.

D. Relate the costs and returns from this marketing method to similar data from available commercial storage facilities or other methods of marketing soybeans.

Potential Benefits: Would provide soybean growers with both a method for evaluating this marketing alternative and some factural data on investment and operating costs. Applying the techniques and data to their own situation, growers should be able to determine the desirability of farm storage to them.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	0	.3	2 1/	1
USDA	.4		X	

1/ Number of states listing this category as the first area of needed funding.

* Priortiy within specific RPA
** Priority as measured overall RPA subgroups.

ECONOMIC EFFICIENCY IN MARKETING SOYBEANS AND THEIR PRODUCTS

RPA 504-B (3*-28**)

Situation: The orderly development of soybean marketing, processing, and supporting service agencies in the Southern region depends on the quantity and quality of data available to segments of the industry for decision making. Relevant data are especially needed by firms in this region since soybeans have developed into an important farm enterprise in recent years. An evaluation of the relative position of the Southern Region as a producer, processor, and consumer of soybeans and soybean products both atpresent and for specified future periods is needed. Estimates of the potential as well as the limitations for expansion of the soybean industry in the region should be determined. The results of these analysis will tend to influence the type, location, and size of additional marketing facilities that will be needed in the future. Present research conducted by the Southern Regional Grain Marketing Committee under project SM-29 will contribute information useful to the soybean industry in assessing future needs and developments. A basic purpose of additional research in this area would be to develop analytical procedures using regularly available data which would aid individual firms in the industry in making both long-term and short-term decisions.

Objective: To determine the present and potential position of the Southern Region in the production and utilization of soybeans and soybean products.

Research Approaches:

A. To examine the present pattern of soybean production and utilization in the Southern Region and the relative position of this area in the U. S. soybean industry.

B. To develop estimates of the potential for expansion of soybean production in this Region in terms of land available, competition with other crops within the Region, and competition with other soybean producing regions.

C. To examine present marketing channels for soybean products (oil and meal) including both domestic and export outlets.

D. To develop estimates of potential markets for soybean products from Southern processors in terms of expected requirements for poultry and livestock needs as well as for food products.

Potential Benefits: Data on current trends in the production and utilization of soybeans furnish a basis for short term decisions by marketing and processing firms. Estimates of future developments in the soybean industry in the Southern Region provide a basis for evaluating long-range needs for marketing and processing facilities.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.4	1.7	3 1/	2 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

ECONOMIC EFFICIENCY IN MARKETING SOYBEANS AND THEIR PRODUCTS

RPA 504-C (2*-27**)

Situation: Soybean production is a relatively new farm enterprise to many producers in the Southern Region. Economic evaluations of soybean production, harvesting, and marketing practices available to producers has been limited in many areas. The rapid expansion in the production of soybeans resulted in a pressing need for economic data on this crop. State Experiment Stations and other agencies in the Region responded to this need, and currently, most Stations are conducting cost studies in soybean production and handling. Since most states have growing areas that differ in soil types, climate, and other characteristics, this type of research must be designed for fairly limited geographical areas. Marketing firms are vitally concerned with the success of research efforts in production since the marketing system must be designed to handle what is produced. Therefore, efforts to improve the profitability of the soybean enterprise, and hence the volume produced, are legitimate concerns of marketing and processing firms.

Objective: To ascertain the costs and returns to growers from soybean production in Major Producing Areas in the Southern Region.

Research Approaches:

A. Determine the inputs, costs, yields, and returns for those systems of soybean production which have proven efficient in major growing areas.

B. In cooperation with other disciplines engaged in soybean research, evaluate new production technology which offer indications of increased profitability.

C. To assess the potential of soybeans to compete with established cash crops for land and other production factors.

Potential Benefits: (1) Increased returns to producers, (2) increased volume of soybeans for processing in the Region, and (3) provide a realistic basis for evaluating future expansion of this crop as a farm enterprise in this Region.

Current and Recommended Research Efforts:

	SYs		Additional Funding Priorities	
	Current	Needed	Support	SYs
SAES	.4	2.0	2 1/	4 1/
USDA				

1/ Number of states listing this category as the first area of needed funding.

* Priority within specific RPA.

** Priority as measured overall RPA subgroups.

Table 1. Soybeans - acreage harvested, 1964-1974.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1,000 acres	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	percent
1964	207	3,318	68	155	246	454	1,293	681	122	677	586	63	335	8,205	30,793	26.6
1965	228	3,550	78	209	295	622	1,461	776	152	806	732	82	345	9,336	34,449	27.1
1966	280	3,728	80	301	310	871	1,797	923	143	879	871	123	355	10,661	36,546	29.2
1967	484	3,989	100	542	388	1,306	2,120	1,117	164	1,046	1,115	258	383	13,012	39,767	32.7
1968	557	3,989	143	472	466	1,436	2,120	972	184	931	1,193	312	372	13,147	41,104	32.0
1969	641	4,228	169	467	485	1,608	2,290	885	204	959	1,193	262	361	13,752	40,982	33.6
1970	609	4,313	184	528	558	1,688	2,313	867	177	988	1,217	158	339	13,939	42,056	33.1
1971	655	4,300	207	600	705	1,644	2,632	990	163	1,070	1,219	103	353	14,641	42,701	34.3
1972	800	4,050	232	670	924	1,667	2,464	1,165	170	1,080	1,298	210	350	15,080	45,698	33.0
1973	970	4,650	254	950	1,140	1,580	2,750	1,450	200	1,250	1,570	425	413	17,602	55,796	31.5
1974[a]	1,020	4,300	279	1,010	1,170	1,760	2,525	1,420	219	1,250	1,520	261	430	17,164	52,460	32.7

a Preliminary

Source: 1961-1964 - Statistical Bulletin 384
1965-1974 - Crop Production - Annual Summary

Table 2. Soybeans - yield per acre.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	bushels															percent
1964	22.0	20.0	25.0	20.0	22.5	20.0	19.0	23.5	16.5	21.5	23.0	26.0	20.0	20.6	22.8	90.4
1965	22.0	21.5	26.0	20.5	24.0	21.5	22.5	25.0	16.5	21.0	23.5	26.0	20.5	22.1	24.5	90.2
1966	24.5	22.5	27.0	23.0	25.0	25.0	23.5	25.0	20.0	22.0	24.5	27.0	18.5	23.3	25.4	91.7
1967	27.0	23.0	28.0	24.0	28.0	23.0	23.5	24.5	22.0	22.5	25.0	26.0	21.5	23.7	24.5	96.7
1968	22.0	22.0	24.0	15.0	26.5	27.0	27.0	17.5	21.0	12.5	21.0	27.0	19.0	22.2	26.8	82.8
1969	23.0	20.5	27.0	24.0	28.0	19.0	22.0	26.5	17.0	22.5	24.0	29.0	25.0	22.2	27.5	80.7
1970	23.5	22.5	28.0	22.5	27.0	22.5	24.0	24.0	17.0	20.5	23.0	28.0	19.0	22.9	26.7	85.8
1971	26.0	21.5	28.0	25.5	29.5	24.0	21.5	24.0	21.5	21.5	26.0	27.0	24.0	23.3	27.5	84.7
1972	20.0	20.0	21.0	15.0	27.0	23.0	19.5	25.0	21.0	18.5	22.0	26.0	23.0	21.1	27.8	75.9
1973	21.0	25.0	24.0	21.0	25.5	22.0	22.0	24.0	23.0	19.0	23.5	20.0	27.0	23.1	27.7	83.4
1974	24.0	20.0	27.0	25.5	25.0	25.5	18.5	22.5	23.0	19.0	21.0	30.0	23.5	21.9	23.5	93.2

Source: 1961-1964 - Statistical Bulletin 284
1965-1974 - Crop Production.

Appendix

Table 3. Soybean production.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	thousand bushels															percent
1964	4,554	66,360	1,700	3,100	5,535	9,080	24,567	16,004	2,013	14,556	13,478	1,638	6,700	169,285	700,921	24.2
1965	5,016	76,325	2,028	4,284	7,080	13,373	32,872	19,400	2,508	16,926	17,202	2,132	7,072	206,218	845,608	24.4
1966	6,860	83,880	2,160	6,923	7,750	21,775	42,230	23,075	2,860	19,338	21,340	3,321	6,568	248,080	928,481	26.7
1967	13,068	91,747	2,800	13,008	10,864	30,038	49,820	27,366	3,608	23,535	27,875	6,708	8,234	308,671	976,060	31.6
1968	12,254	87,758	3,432	7,080	12,349	38,772	57,240	17,010	3,864	11,638	25,053	8,424	7,068	291,942	1,103,129	26.5
1969	14,743	86,674	4,563	11,208	13,580	30,552	50,380	23,453	3,468	21,578	28,632	7,598	9,025	305,454	1,126,314	27.1
1970	14,312	97,043	5,152	11,880	15,066	37,980	55,512	20,808	3,009	20,254	27,991	4,424	6,441	319,872	1,123,740	28.5
1971	17,030	92,450	5,796	15,300	20,798	39,456	56,588	23,760	3,505	23,005	31,694	2,781	8,472	340,635	1,175,989	29.0
1972	16,000	81,000	4,872	10,050	24,948	38,341	48,048	29,125	3,570	19,980	28,556	5,460	8,050	318,000	1,270,630	25.0
1973	20,370	116,250	6,096	19,950	29,070	34,760	60,500	34,800	4,600	23,750	36,895	8,500	11,151	406,692	1,547,165	26.3
1974	24,480	86,000	7,533	25,755	29,250	44,880	46,713	31,950	5,037	23,750	31,920	7,830	10,105	375,203	1,233,425	30.4

Source: 1961-1964 - Statistical Bulletin 384.
1965-1974 - Crop Production

Table 4. Soybean - value of production.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	thousand dollars															percent
1964	12,023	175,854	4,318	7,905	14,391	22,791	65,840	42,091	4,992	37,700	34,504	4,013	17,621	444,043	1,836,441	24.2
1965	12,390	195,392	4,948	10,410	17,558	32,229	81,523	46,948	5,819	42,823	41,285	4,776	17,609	513,710	2,151,305	23.9
1966	19,277	234,864	6,156	19,384	21,235	62,059	117,822	65,302	7,665	54,533	59,112	8,635	18,390	694,434	2,553,612	27.2
1967	32,670	228,450	7,028	32,000	26,617	75,095	125,546	67,594	8,551	59,073	67,736	15,831	20,091	766,282	2,432,564	31.5
1968	29,655	215,007	8,374	17,346	29,514	94,604	140,238	41,504	8,849	28,746	59,877	19,628	17,246	710,588	2,679,210	26.5
1969	34,056	208,884	10,951	27,348	31,506	72,103	120,408	55,584	7,526	51,140	66,140	16,564	21,389	723,599	2,647,499	27.3
1970	40,360	279,484	14,941	35,046	42,938	109,003	162,095	60,343	8,034	58,534	78,095	11,547	18,743	919,163	3,204,650	28.7
1971	49,728	277,350	16,808	43,758	61,562	119,552	172,028	68,429	9,919	68,325	91,279	8,204	25,331	1,012,273	3,559,708	28.4
1972	60,960	334,530	17,539	43,316	101,289	148,763	201,321	120,286	15,101	83,716	116,223	22,495	32,442	1,297,981	5,550,459	23.4
1973[a]	106,260	651,000	34,442	110,723	161,339	220,590	338,800	201,600	24,610	134,188	201,078	44,625	61,331	2,290,586	8,724,231	26.3

a Preliminary

Source: 1964 - Statistical Bulletin 404
1965-1974 - Fiedl & Seed Crops - production, farm use, sales and value, by states - Annual Summaries.

Table 5. Soybeans - amount fed to livestock on farms where grown.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	thousand bushels															percent
1964	14	0	2	31	11	0	0	80	12	58	54	2	67	331	853	38.8
1965	15	0	0	39	14	0	0	78	15	34	52	2	57	306	866	35.3
1966	14	0	4	48	16	0	0	92	23	39	43	3	59	341	957	35.6
1967	26	0	6	52	11	0	0	82	29	47	28	0	33	314	948	33.1
1968	12	0	7	28	12	0	0	51	12	23	25	0	35	205	846	24.2
1969	15	0	9	45	14	0	0	70	10	43	29	0	90	325	886	36.7
1970	14	0	10	24	15	0	0	104	9	41	28	0	39	284	1,039	27.3
1971	17	0	12	15	21	0	0	119	11	46	32	0	34	307	1,082	28.4
1972	16	0	10	30	25	0	0	146	21	40	29	0	48	365	1,115	32.7
1973[a]	19	0	12	40	29	0	0	180	18	48	37	0	56	439	1,463	30.0

a Preliminary

Source: Same as Table 4.

Table 6. Soybeans - amount used for seed on farm where grown.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	thousand	bushels - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	percent
1964	92	1,970	20	116	122	35	540	585	49	600	341	15	204	4,689	21,219	22.1
1965	93	1,880	20	146	118	49	627	649	47	653	358	22	214	4,876	21,890	22.3
1966	108	1,993	20	262	208	88	970	552	55	711	427	45	266	5,705	23,262	24.5
1967	157	1,771	19	236	227	97	960	512	57	614	380	68	215	5,313	22,641	23.5
1968	205	1,895	26	206	231	85	778	212	88	595	380	57	257	5,015	21,671	23.1
1969	146	1,538	31	264	280	87	786	218	80	619	357	56	237	4,699	20,922	22.5
1970	160	1,507	35	317	194	136	437	466	78	650	378	41	215	4,614	20,200	22.8
1971	117	1,697	39	302	249	154	464	341	83	468	389	82	195	4,580	20,822	22.0
1972	143	1,927	43	352	234	97	453	543	95	520	394	45	260	5,106	22,829	22.4
1973[a]	158	1,804	45	370	352	96	445	543	115	536	394	80	281	5,219	23,358	22.3

a Preliminary

Source: Same as Table 4.

Table 7. Soybeans - amount sold.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - thousand	bushels - -	- - -	- - -	- - -	- - -	- - -	- - -	percent
1964	4,448	64,390	1,678	2,953	5,402	9,045	24,027	15,339	1,952	13,898	13,083	1,621	6,429	164,265	678,849	24.2
1965	4,908	74,445	2,008	4,099	6,948	13,324	32,245	18,673	2,446	16,239	16,792	2,108	6,801	201,036	822,852	24.4
1966	6,738	81,887	2,136	6,613	7,526	21,687	41,260	22,431	2,782	18,588	20,870	3,273	6,243	242,034	904,262	26.8
1967	12,885	89,976	2,775	12,720	10,626	29,941	48,860	26,772	3,522	22,874	27,467	6,640	7,986	303,044	952,471	31.8
1968	12,037	85,863	3,399	6,846	12,106	38,687	56,462	16,747	3,764	11,020	24,648	8,367	6,776	286,722	1,080,612	26.5
1969	14,582	85,136	4,523	10,899	13,286	30,465	49,594	23,165	3,378	20,916	28,246	7,542	8,698	300,430	1,104,506	27.2
1970	14,138	95,536	5,107	11,539	14,857	37,844	55,075	20,238	2,922	19,563	27,585	4,383	6,187	314,974	1,102,501	28.6
1971	16,896	90,753	5,745	14,983	20,528	39,302	56,124	23,300	3,411	22,491	31,273	2,699	8,243	335,748	1,154,085	29.1
1972	15,841	79,073	4,819	9,668	24,689	38,244	47,595	28,436	3,454	19,420	28,133	5,415	7,742	312,529	1,246,686	25.1
1973[a]	19,143	114,446	6,039	19,540	28,689	38,604	60,055	35,277	4,467	23,166	36,464	8,420	10,814	405,124	1,541,697	26.3

a Preliminary

Source: Same as Table 4.

Table 8. Soybeans - season average price per bushel.[a]

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Av. 13 S. states	Av. U.S.	% South is of U.S.
	dollars															percent
1964	2.64	2.65	2.54	2.55	2.60	2.51	2.68	2.63	2.48	2.59	2.56	2.45	2.63	2.62	2.62	100.0
1965	2.47	2.56	2.44	2.43	2.48	2.41	2.48	2.42	2.32	2.53	2.40	2.24	2.49	2.49	2.54	98.0
1966	2.81	2.80	2.85	2.80	2.74	2.85	2.79	2.83	2.68	2.82	2.77	2.60	2.80	2.80	2.75	101.8
1967	2.50	2.49	2.51	2.46	2.45	2.50	2.52	2.47	2.37	2.51	2.43	2.36	2.44	2.48	2.49	99.6
1968	2.42	2.45	2.44	2.45	2.39	2.44	2.45	2.44	2.29	2.47	2.39	2.33	2.44	2.43	2.43	100.0
1969	2.31	2.41	2.40	2.44	2.32	2.36	2.39	2.37	2.17	2.37	2.31	2.18	2.37	2.37	2.35	100.9
1970	2.82	2.88	2.90	2.95	2.85	2.87	2.92	2.90	2.67	2.89	2.79	2.61	2.91	2.87	2.85	100.7
1971	2.92	3.00	2.90	2.86	2.96	3.03	3.04	2.88	2.83	2.97	2.88	2.95	2.99	2.97	3.03	98.0
1972	3.81	4.13	3.60	4.31	4.06	3.88	4.19	4.13	4.23	4.19	4.07	4.12	4.03	4.08	4.37	93.4
1973[b]	5.50	5.60	5.65	5.55	5.55	5.70	5.60	5.60	5.35	5.65	5.45	5.25	5.50	5.58	5.57	100.2

a Includes allowance for unredeemed loan and purchases by the Government at the average loan and purchase rate by states.
b Preliminary.

Source: Same as Table 4.

Table 9. Soybeans - value of sales.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	thousand dollars															percent
1964	11,743	170,634	4,262	7,530	14,045	22,703	64,392	40,342	4,841	35,996	33,492	3,971	16,908	430,859	1,778,649	24.2
1965	12,123	190,579	4,900	9,961	17,231	32,111	79,968	45,189	5,675	41,085	40,301	4,722	16,934	500,779	2,093,304	23.9
1966	18,934	229,284	6,088	18,516	20,621	61,808	115,115	63,480	7,456	52,418	57,810	8,510	17,480	677,520	2,487,087	27.2
1967	32,212	224,040	6,965	31,291	26,034	74,852	123,127	66,127	8,347	57,414	66,745	15,670	19,486	752,310	2,373,803	31.7
1968	29,130	210,364	8,294	16,773	28,933	94,396	138,332	40,863	8,620	27,219	58,909	19,495	16,533	697,861	2,624,566	26.6
1969	33,684	205,178	10,855	26,594	30,824	71,897	118,530	54,901	7,330	49,571	65,248	16,442	20,614	711,668	2,596,315	27.4
1970	39,869	275,144	14,810	34,040	42,342	108,612	160,819	58,690	7,802	56,537	76,962	11,440	18,004	905,071	3,144,159	28.8
1971	49,336	272,259	16,661	42,851	60,763	119,085	170,617	67,104	9,653	66,798	90,066	7,962	24,647	997,802	3,493,423	28.6
1972	60,354	326,571	17,348	41,669	100,237	148,387	199,423	117,441	14,610	81,370	114,501	22,310	31,200	1,275,421	5,445,680	23.4
1973	105,287	640,898	34,120	108,447	159,224	220,043	336,308	197,551	23,898	130,888	198,729	44,205	59,477	2,259,075	8,586,282	26.3

Source: Same as Table 4.

Table 10. Number of processors of soybeans by states, 1965-1974.

Year	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N.C.	Okla.	S.C.	Tenn.	Tex.	Va.	Total 13 S. states	Total U.S.	% South is of U.S.
	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	number	- - -	- - -	- - -	- - -	- - -	- - -	percent
1965	4	9	1	2	2	2	13	7	4	7	7	4	1	63	131	48.1
1966	4	9	0	2	2	2	14	7	4	7	7	4	1	63	132	47.7
1967	4	10	0	3	2	2	15	6	4	8	7	4	1	66	133	49.6
1968	3	11	0	3	2	3	15	6	4	8	7	5	1	68	134	50.7
1969	3	11	0	4	2	3	14	6	4	7	8	5	1	68	131	51.9
1970	3	11	0	5	2	4	15	6	2	7	8	5	1	69	125	55.2
1971	3	9	0	4	2	3	14	6	3	7	6	5	1	63	117	53.8
1972	3	7	0	4	2	3	14	6	3	7	6	3	1	59	117	50.4
1973	2	7	0	4	2	3	15	6	3	4	6	3	1	56	111	50.5
1974	2	7	0	4	2	3	14	6	3	4	6	3	1	55	109	50.5

Source: Soybean Digest - published annually in March by American Soybean Assn. and Soybean Council of America, Inc.

Table 11. Disposition of soybeans, 1964-1973.

		Proportion		
	Ave. prod. 1964-73	Fed to livestock	Used for seed	Sold
Alabama	12,421	0.1	1.1	98.8
Arkansas	87,949	0.0	2.0	98.0
Florida	3,860	0.2	0.8	99.0
Georgia	10,278	0.3	2.5	97.2
Kentucky	14,704	0.1	1.5	98.4
Louisiana	29,413	0.0	0.3	99.7
Mississippi	47,776	0.0	1.4	98.6
North Carolina	23,480	0.4	2.0	97.6
Oklahoma	3,301	0.5	2.3	97.2
South Carolina	19,456	0.2	3.1	96.7
Tennessee	25,872	0.1	1.5	98.4
Texas	5,099	a	1.0	99.0
Virginia	7,878	0.7	3.0	96.3
Average, S. Region	291,485	0.1	1.7	98.2
Average, U. S.	1,079,804	0.1	2.0	97.9

a Less than 0.05%

Table 12. Soybeans: supply and disposition, U. S.

Year	Supply (carry over and prod.)	Proportion used for						
		Crushing	Exports	Seed	Feed	Residual	Ending stock	Total
	mil. bu.	percent						
1959	620.7	63.5	22.5	4.7	0.2	0.7	8.4	100.0
1960	606.9	66.9	22.2	5.4	0.2	0.8	4.5	100.0
1961	705.7	61.1	21.2	4.7	0.2	1.7	11.1	100.0
1962	747.5	63.3	24.1	4.6	0.1	1.7	6.2	100.0
1963	745.2	58.6	25.1	4.8	0.1	2.3	9.1	100.0
1964	768.2	62.4	27.6	5.2	0.1	0.8	3.9	100.0
1965	875.3	61.4	28.6	4.9	0.1	0.9	4.1	100.0
1966	964.1	58.0	27.1	4.9	0.1	0.5	9.4	100.0
1967	1,066.5	54.0	25.0	4.6	0.1	0.7	15.6	100.0
1968	1,273.3	47.6	22.5	3.7	0.1	0.4	25.7	100.0
1969	1,459.9	50.5	29.6	3.3	0.1	0.7	15.8	100.0
1970	1,356.9	56.0	32.0	3.5	0.1	1.1	7.3	100.0
1971	1,274.8	56.5	32.7	4.0	0.1	1.1	5.6	100.0
1972	1,342.6	53.8	35.7	4.5	0.1	1.5	4.4	100.0
1973[a]	1,626.1	50.5	33.3	3.6	0.1	1.9	10.6	100.0

a Preliminary

Source: Fats and Oils Situation.